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The Role and Potential of Trees, Shrubs and Herbs among the Pastoralists of Tanzania

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INTRODUCTION

The semi-arid area of Central Tanzania carries over 15, 8, and 4 per cent of the national cattle, goats and sheep population, respectively. A possible reason for such a large number of livestock is because the area is free from tse tse flies and various diseases, and partly because rainfall is insufficient for reliable cash crop production. During the dry season, farmers experience considerable problems providing their livestock with sufficient forage of adequate feeding value. The nutritional value of grasses and legumes rapidly declines with progression of the dry season. However some trees and shrubs remain green or start sprouting in the dry season. During the wet season browsing is mainly important to small ruminants. Other studies have stated that forb shrubs are well fermented in the rumen and that some shrubs of good nutritional value may enhance the dry matter intake of other forages of lower value (Backlund and Bellskog, 1991). Legume trees and shrubs apart from being good sources of high quality feed for ruminant livestock, also have several advantages directly or indirectly related to livestock production. Trees and shrubs have provided valuable forage to man's herbivorous animals probably since the time such animals were domesticated (Robinson, 1985). At least 75 per cent of the shrubs and trees of Africa serve as browse plants (Skerman, 1977).

Importance of Woody Plants as Forage

Forage productivity in arid and semi-arid lands (ASALs) closely reflects rainfall, which is highly variable in amounts, and in temporal and spatial distribution. Although occasional periods of high rainfall and subsequent high forage productivity occur, both are usually quite low. Ephemeral grasses and herbs, although grown well under adequate rainfall, are overall not a particularly reliable forage source in arid areas. Perennial (mostly woody) vegetation is the first and often only vegetation to flourish significantly following low rainfalls. It also remains green longer into the dry season than does ephemeral vegetation.

Tree leaves and pods form a natural part of the diet of many ruminant species and have been used traditionally as a source of forage for domesticated ruminants (Le Honerou, 1980). More than 200 species of leguminous tree are reported to be used as forage, with most species being tropical in origin. It is reported that the most commonly used species come from the genera *Acacia, Albizia, Calliandra, Desmanthus, Desmodium, Gliricidia, Leucaena, Prosopis and Sesbania.* Tree and shrub legumes have mostly been used as feed for ruminants, although there are some reports of their inclusion in the diet of non-ruminants (pigs and poultry). The leaves, stems and fruits may be used either as a complete feed or as a supplement to the feeds. In some species, the presence of toxic and/or anti-nutritional factors is a major limitation to the use of one or more of these components.

Woody Species Among Pastoral Communities

Pastoralism involves contingent responses to a wide range of variables in the physical and social environment (Tandingar, 1994). Consequently, African pastoralists have acquired extensive knowledge of the major environmental components and their relations to production and survival, particularly the management of their main source of livelihood, *i.e.* livestock.

The study conducted by Mwilawa (1996) identified 27 naturally occurring useful woody species. The most useful multipurpose trees observed were *Acacia tortilis, Acacia senegal, Acacia dropanolobium, Acacia albida* and *Delonix elata.* Other multipurpose tropical trees, which have demonstrated high potential for increased ruminant production (*Leucaena* spp, *Gliricidia sepium, Calliandra calothyrsus, Sesbania* spp and *Desmathus virgatus*), may be introduced (Backlund and Bellskog, 1991; Kusekwa and Msafiri. 1993 and Komwihangilo et al., 1993).

Fodder from Leguminous Trees as Forage Supplement

Leguminous trees are important sources of supplemental fodder, pasture grasslands which are losing ground to other land uses and loss of soil fertility. Nomadic pastoralism conflicts with modern tenure laws, land herding people are forced to settle on grazing. One result of all this, is a growing dependency on perennial tree and shrub fodder. Efforts are made by researchers in dealing with a small holder farmer in establishing and promoting the use of some leguminous trees as source of fodder or protein source. *Acacia* spp. and *Albizia* spp. are extensively naturally found in these areas with high nutritive value in their pods and fodder. *Leucaena leucocephala*, *Sesbania* spp. and *Cajanus cajan* are established or incorporated in farming systems for fodder and other uses.

Glilicidia spp. and *Faidherbia* spp. are also used, however evaluation work is on-going. These trees draw on soils with moisture and nutrients that are not available to shallow-rooted grass forages. Many of those trees ration their leaves and continue to provide feed during periods of drought and environmental stress when grasses either become unpalatable or dormant. Leguminous trees like other trees have animal defence mechanism that may reduce their worth as fodder. Few studies have been conducted to examine the feed value of various tree fodders and thus there is little to guide those who are supplementing livestock diets with the fodder.

Description of Some Leguminous Trees in Central Tanzania

There is a great variation in browse productivity which is closely related to climatic and ecological conditions, and may range from 100-1000kg of edible dry matter (DM) per ha per year (Le Houerou, 1980). Most literature provide the total biomass production of the browse species, and relatively few publications provide adequate information in relation to animal production. Total biomass production is only valuable if the livestock can ingest the whole plant. Also, information on the production of the most palatable and nutrition parts of the plant (*e.g.* leaves) is meaningful only in the context of the zero grazing systems when the farmer cuts and carries required plant components to the animal, or when the plant is short enough to be accessible to the animals.

Leucaena leucocephala: The plant is adaptable to a large extent in the central areas and found among agropastoralitsts and pastoralists. It is valued for its ability to withstand repeated defoliation, high yields of foliage and its tolerance to low soil fertility. *Leucaena* spp. that have shown potential are *L. collinsii, L. diversfolia, L. esculenta* and *L. pulverulenta.* These have yielded an average 5-8 tonnes DM/ha/yr. The crude protein content of the forage was estimated to be 23 per cent. (Kusekwa et al., 1991). The slow early growth and the risk of animal poisoning are disadvantages. Farmers have planted *Leucaena leucocephala* for fodder use in small plots, others around the fields and houses. This is encouraged mainly for cut and carry practice. Unfortunately, this species as has been reported to be attacked by the leucaena psyllid (*Heterophylla cubana*) which has threatened destruction of thousands of hactares under this fodder tree in South-East and Australia (Napompeth and MacDicken, 1990), it has also been attacking most parts including central Tanzania. To which end scientist are looking on alternative specie to leucaena.

Sesbania species: The specie is widely spread on stream banks and besides seasonal ponds, survives in water logging. This has been the mostly likely alternative to *Leucaena leucocephala* because of their known multipurpose

uses. It is reported that several species of sesbania are excellent as livestock feed, both as fresh fodder and hay. Dry matter (DM) yields of Sesbania forage are quite high when compared to other forage legumes in the fisrt year of establishment (Kusekwa et al., 1993). *Sesbania sesban* and *Sesbania goetzei* have shown great potential, yielding annually as much as 8 tonnes dry matter (DM) per hectare of forage (leaf, young twigs and pods). With a crude protein (CP) content of around 20 per cent in the establishment year (Kusekwa et al., 1991).

Acacia species: Most of them are nitrogen fixing trees common in the semi-arid and arid tropical areas and very common in the drier areas of East Africa (Le Houerou, 1980). Studies on herbage production of *Cenchrus ciliaris* intercropped with *Acacia tortilis* have shown that herbage production of grasses were not affected, and that they remained productive for up to 5 years (Roy et al., 1980, 1982). Among the Gogo agropastoralists and the Masai pastoralists the trees have the following uses: fodder (leave, shoots and pods), bee foliage, timber, soil conservation, soil improvement, firewood, charcoal, poles, posts, mulch. In crop-livestock integration for the Gogo agropastoralists of central Tanzania, the plant provides a favourable micro-climate for the crops especially when appropriate space is used, provides shade to livestock and fence by cutting branches (Mwilawa, 1996). He further noted that the Maasai pastoralists use the bark as fibre.

Nutritive Value of Some Trees/browses Studied

The potential of trees/shrubs to produce quality feeds and continue growth during the dry season together with their ability to stand grazing in grass/legume mixtures, has stimulated efforts in tree/browse evaluation in these areas. Studies on the role of local trees and shrubs in livestock production during wet and dry season have been carried out in central Tanzania (Olsson and Welin-Berger, 1989; Backlund and Bellskog, 1991). Olsson and Welin-Berger (1989) did a preliminary evaluation of a number of naturally growing browses in Central Tanzania. The study showed high mineral contents, crude protein and apparent *in vitro* digestibility in most of the browses, while others had substantial amount of lignin and soluble phenolics. Based on nutritional merits of the two studies, five species were selected and recommended for further studies (Table 1). Mineral content of the shrubs in semi-arid areas of Tanzania [as estimmated by Backlund and Bellskog (1990)] showed shrubs to contain sufficient calcium and phoshorus for animal requirements (Table 2) and shrubs were found to be fairly good source of macronutrients. *Acacia tortilis* were used in feeding trial by Shayo (1992) and it was determined prior that pod production per tree per season ranged from 28 - 206kg. Chemical analysis are shown in table 3, comparing them to those of sunflower cake as a supplement.

Backlund and Bellskog (1991) observed a range between 10 and 30 per cent of crude

Table 1: Chemical Composition (% of DM) of the Most Promising Local Browse Species in Semi-arid Tanzania

Species	*ASH*	*CP*	*NDF*	*ADF*	*ADL*	*SPHEN*	*IVOMD*
Delonix elata	7	25	32	13	5	21	79
Grewia similis	10	17	37	19	7	14	77
Albizia harveyii	-	23	-	-	-	13	-
Cadaba farinosa	20.7	17	18	11	4	18	78
Combretum guanzii	9.9	19	37	21	9	11	74

Source: Backlund and Bellskog (1990) and Olsson and Welin-berger 1989

NDF = Neutral Detergent fibre
ADF = Acid Detergent fibre
ADL = Acid Detergent lignin
SPHEN = Soluble phenolics
IVOMD = In vitro organic matter digestibility

Table 2: Mineral Content of Shrubs as Per Cent of Dry Matter in Semi-arid Areas of Tanzania

Species	*Ca*	*P*	*Mg*	*K*
Acacia tortilis	1.5	0.3	0.3	1.7
Delonix elata	4.6	0.1	0.4	0.6
Grewia similis	3.5	0.2	0.4	2.2
Albizia harveyii	0.9	0.3	0.5	1.7
Cadaba farinosa	2.0	0.2	1.3	9.7

Source: Backlund and Bellskog (1990)

protein content of the shrubs, with a mean of 19 per cent. The outstanding specie was *Albizia harveyii* (240 2/kg DM) while at the other extreme, samples of *Cordia gharaf* had very low digestibility of crude protein. High TDOM values corresponded with low levels of NDF. The overall mean of TDOM did not differ from the values obtained during the wet season (Olsson and Welin-Berger, 1989). The use of *L. leucocephala* as a supplement to mature grass has shown that neither grass intake nor digestibility of total rations could be improved, but benefits include intakes of nutrients from the legume (Mero and Udden, 1990).

Forage Production in Agrosilvopastoral System

Lugenja et al. (1988) reported an increase on forage production when browse species were included in the grazing land. The increase was 9.6 tonnes DM per hectare as a browse contribution (Table 4). The reported increase in forage production as a result of inclusion of browse plants is well understood by pastoralists. They usually graze a mixed herd of different class of stocks as a means to proper utilization of the rangelands. However, Mwilawa (1996) on his study among the pastoral communities of central and northen Tanzania argued that the practice should consider other range-management principles, e.g. proper number of stock (Kusekwa et al., 1992) and their distribution, to prevent range overuse and deterioration.

Table 3: Chemical Composition (% DM) of Different Components of Acacia Tortilis Pods and Sunflower Cake Composition, % of DM

Specie	*DM%*	*Ash*	*CP*	*NDF*	*ADF*	*ADL*	*EE*
A. tortilis seeds	91.2	3.7	18.6	42.8	25.3	6.8	1.4
A. albizia seeds	90.1	3.4	28.3	44.0	13.5	5.2	2.3
A. tortilis empty pods	89.3	4.5	9.3	45.0	37.7	7.7	0.8
A. albida empty pods	90.9	3.2	8.3	42.9	35.4	6.3	0.3
A. tortilis whole fruit	90.2	4.1	13.4	44.0	32.2	7.3	1.1
A. albida whole fruit	90.8	3.2	10.4	43.9	33.1	6.2	0.5
Sun flower cake	94.7	6.6	25.8	62.3	41.9	12.9	65.1

Source: Shayo, (1992)

Table 4: Mean Browse Production in Tonnes DM Hectare at Kongwa plains

	SITE			
Species	*1*	*2*	*3*	*Mean*
Grewia spp	0.60	-	-	0.20
Acacia tortilis	-	2.56	-	0.85
Acacia misera	-	8.52	-	2.84
Cadaba kirkii	0.32	0.24	0.76	0.44
Digitaria pubescens	2.51	-	-	0.84
Euphorbia cureata	1.58	1.70	-	1.09
Blepharespermum zanguebaricum	8.40	-	-	2.80
Vitex Sp	1.63	-	-	0.54
Total	15.04	13.02	0.76	9.60

Source : Lugenja et al. (1988)

The Role of Silvopastoral Systems in Rangelands

To a large extent, population density is the major determining factor in the development of silvopastoral production systems. Under low population density pastoralism, access to extensive grazing areas and extensive ranching for beef production is possible. Under intermediate population densities, an intensification of resources management is inevitable. When high population densities occur, most of the pastoralists are pushed to more and more marginal land and hence less grazing areas are available.

Trees, shrubs and herbs play important roles to pastoralists level and regional or global

ecosystem level. Pastoralists hardly ever adopt a technology for its potential contribution at the ecosystem level. New technologies based on the use of trees, shrubs and herbs must be made attractive and conform to their traditional practices. On the other hand, awareness by decision - makers of potential benefits at regional levels should lead to policies fostering the adoption of silvopastoral systems. At the pastoral level, there are several potential roles of trees, shrubs and herbs in pastoral areas are several:

Forage: With typical characteristics of pastoral rangelands the role of forage trees, shrubs and herbs is of great importance. During dry season, pastoralism face shortage of feed in both quantity and quality. The continued availability of green foliage from trees, shrubs and herbs supplements the feeds and provide grazing areas.

Shade: The continued removal of available grazing land from pastoralists calls for intensification of pastoral herds. The systems shift from beef into more semi-intensive dual purpose system. In some cases this shift occurs together with upgrading of stock for more production potential. These more efficient stock require some cool climate. Presence of these trees, shrubs and herbs might be an essential component.

Live Fence: Otysina et al. (1985) and Mwilawa (1996) observed that with continual decline of Ujamaa Villagization more people are willing to own private reserve grazing land. These reserve grazing areas usually are locally fenced by planting chosen trees around their land. These are less costly compared to artificial fences.

Medicinal: Some of the species found among the pastoral communities are used as human and animal medicinal plants (Ole-Lengisugi, 1994). Several species, for instance *Azadirachta indica* (commonly referred as mwarobaini,) have been reported. More research is on-going to study this indigenous technical knowledge.

Roles at Ecosystem Level

Although the important benefits accrued from the integration of trees and pastures may not be directly relevant to pastoralists, they are extremely important for the conservation of land resources and the environment as a whole. Politicians and decision makers at the national and international levels should be fully aware of these potential roles.

Soil Water Conservation: Pastoralist have bylaws that protect cutting of certain woody species in particular areas, *e.g* water catchment areas. Some pastures with high cover when integrated with trees/shrubs help prevent soil erosion in hilly areas. However, on steep slopes and in water sheds, pastoralists are aware of maintaining undisturbed forest. Other roles include capture of carbon dioxide, colour and reflective power of vegetation which varies with species (*Albedo*) and economic growth (Toledo and Torres, 1988).

CONCLUSION AND RECOMMENDATION

It can be concluded that trees, shrubs and herbs have important role to play among the agropastoralist and pastoralist communities in Tanzania. Most of the introduced trees and shrubs have limitation in their growth potential by either climatic or edaphic factors. Some have shown to have anti-nutritional compound like mimosine in Leucaena. Pests are also threatening some species-again Leucaena. Due to this limitation, it is therefore necessary to focus our attention to locally available browse plants which are already adapted to most pastoral environments. Thus, there is a need to incorporate indigenous knowledge on these resource utilizations and priorities into our approach to silvopastoral systems. With the continue removal of land resources from the pastoral production systems and environment change it becomes more important to protect and promote conservation of this resource.

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